Pre-Fire Baseline Stream Sediment and Stream Water Geochemical Data from a Recently Burned Area in Central Idaho, and Suggestions for Application of Geochemical Data to Wildfire Science

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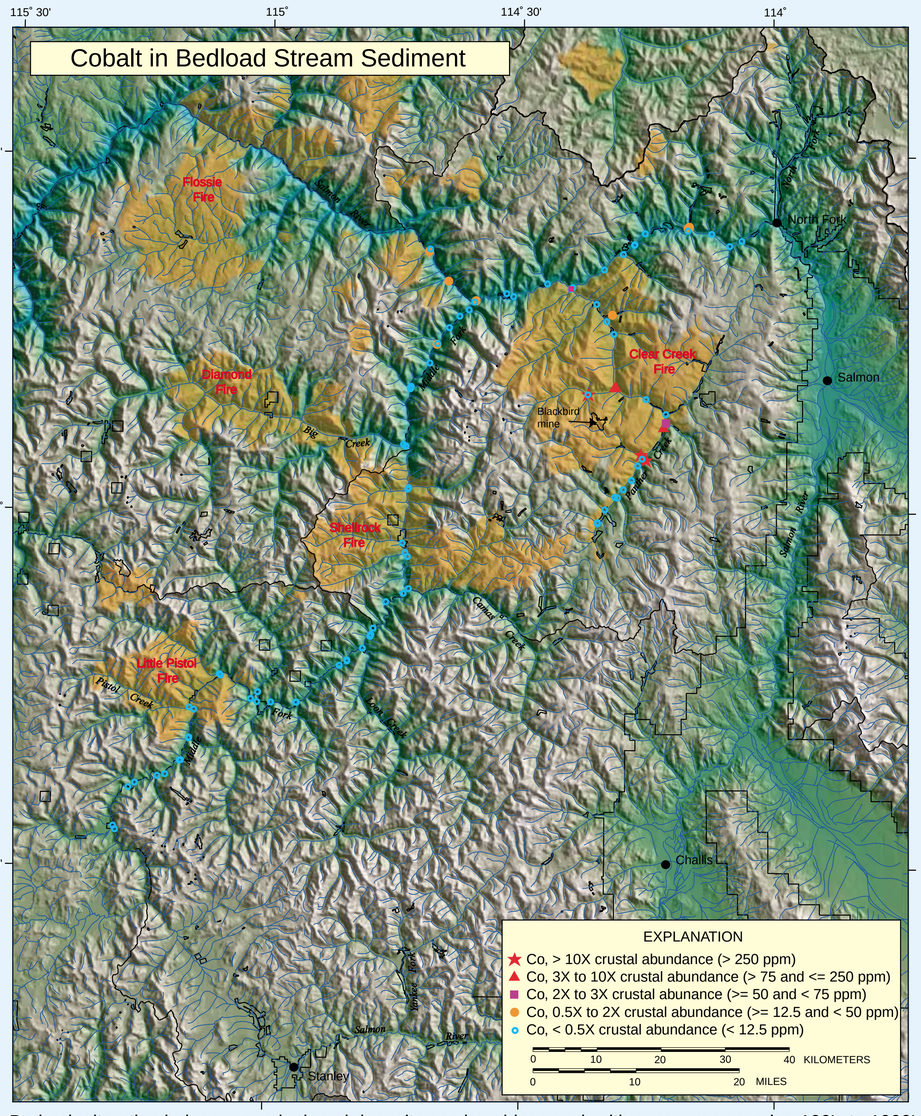
Clear Creek fire, near Cove Creek helibase, August 2000

Clear Creek fire, from Deep Creek road, August 2000

all photographs shown here are from the USFS Salmon-Challis National Forest web page http://www.fs.fed.us/r4/sc/fire2000

A baseline sediment and water sampling geochemical study was undertaken by the USGS Geoligic Divsion in central Idaho in 1996. During the summer of 2000, much of the previously-studied area was burned by the Clear Creek (> 206,000 acres) and Wilderness Complex (> 182,000 acres) fires. These pre-fire baseline geochemical data may be useful in determining chemical effects on the geochemical landscape resulting from the widespread wildfires.

Clear Creek fire aftermath, unspecified area, August 2000

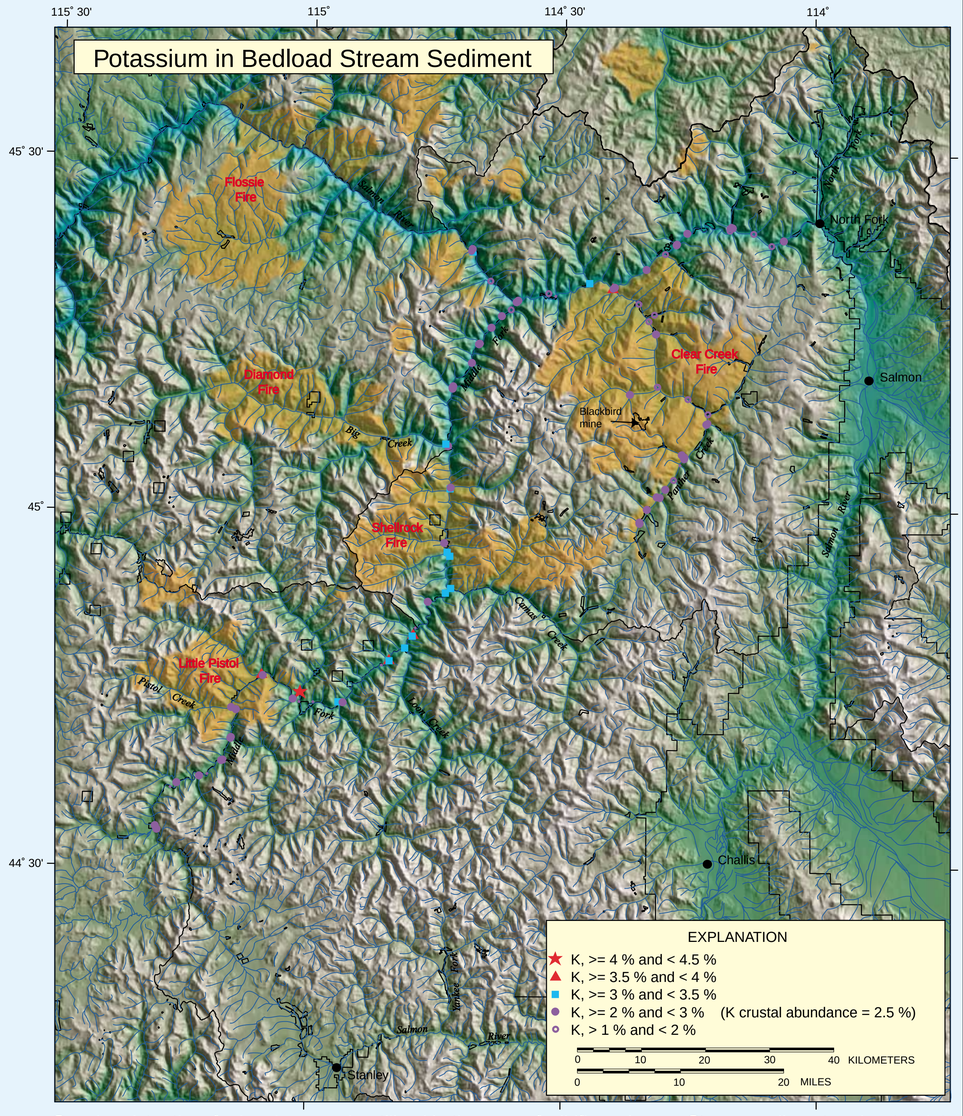


Bedload stream sediment and stream water samples were collected from most of the Panther Creek drainage, from the Main Salmon River between Wagonhammer and Corn Creek, and from the Middle Fork of the Salmon River between Boundary Creek and confluence with the Main Salmon River. The samples were collected from 93 sites during a three-week period in July, 1996. Sites chosen included the main river channels and major tributaries. Composite bedload stream sediments were sieved in the laboratory to minus-80 mesh. Composite stream water samples collected included sub-samples of both filtered and unfiltered water that were analyzed for cations and anions.

Current plans are to re-occupy these sites in 2001 and and collect samples during similar flow level conditions, to allow for comparison of pre-fire and post-fire geochemical effects on the streams and associated sediments.

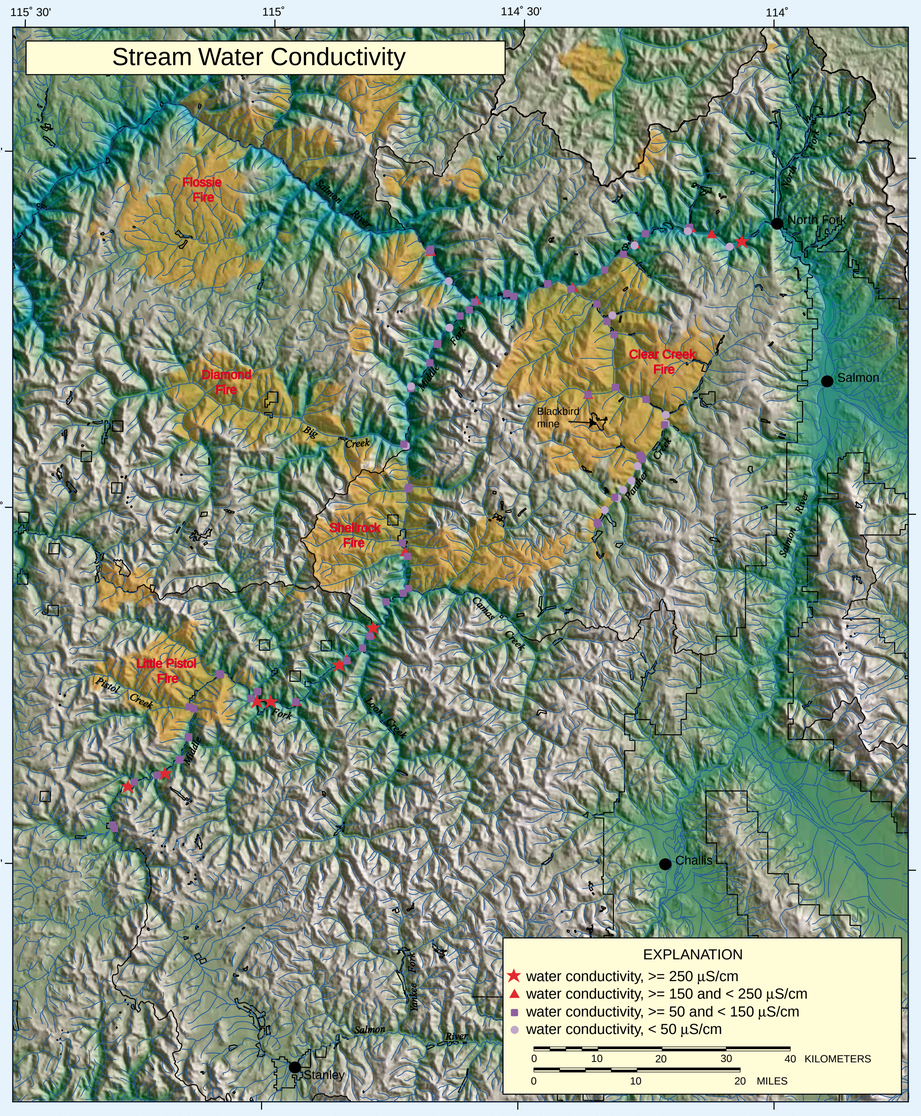
Clear Creek fire, from Deep Creek road, August 2000

Clear Creek fire, above Bookers along Panther Creek, August 2000



Bedrock alteration haloes around mineral deposits can be widespread, with exposures covering 100's to 1000's of acres. These haloes can contain high concentrations of metals such as As, Co, Cu, Fe, Hg, Mn, Pb, S, Se and Zn. Abandoned or active mines in a given basin can produce additional potential environmental problems. ***The high Co in sediment here is derived from the now-burned Blackbird Cu-Co mine area. What will result when the As-Co-Cu-rich soils surrounding the mine move downstream during runnoff and landslide events?***

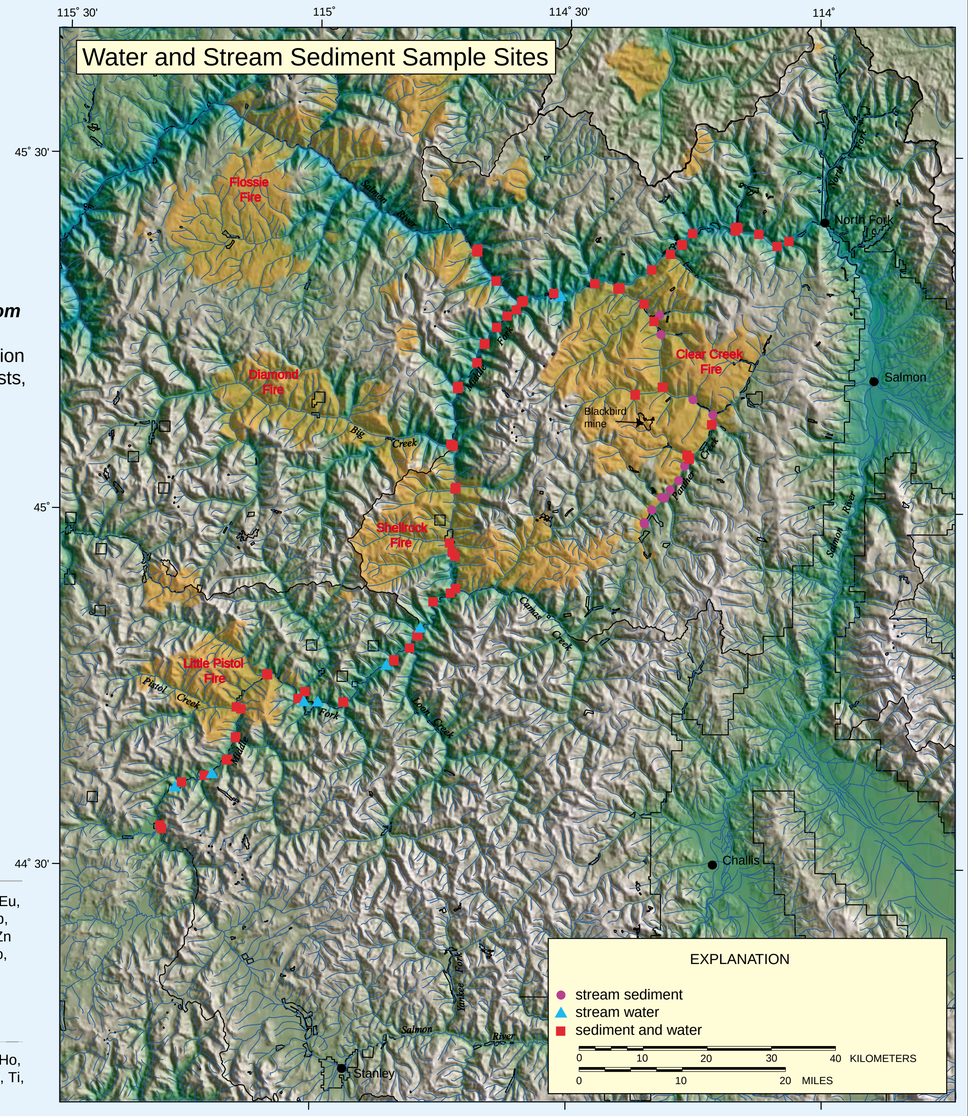
Geochemistry thus far has been underutilized in the area of wildfire science. Stream sediment and water data may identify unusual enrichments of geologically-derived nutrients, such as K, P, Na, and Mg available in the drainage basin upstream. After a wildfire in the basin, these nutrients would likely become mobilized and re-distributed during subsequent runoff and landslide events. Similarly, pre-fire sediment and water data may identify metals in the drainage basin that could, when mobilized, become potential contaminants downstream.



Vegetation, although not sampled during the 1996 study, could provide further clues to metals that could be mobilized following wildfires. It is well known that some plant species can accumulate high concentrations of certain elements in their tissues. In the past, this feature has been utilized as a biogeochemical prospecting tool, because the elements in most plants ultimately have underlying geologic sources. Following a wildfire, non-volatile elements that were present in the plant tissues will become concentrated in the remaining ash. These concentrations in ash would be significantly greater than those in the unburned vegetation. Further, some of these elements could become bioavailable to aquatic biota during subsequent runoff.

A simple laboratory water leach of the ash and upper soil profile, from samples collected immediately following the fire, would provide an indication of readily-soluble metals present in the ash. This information could be useful for those involved in remediation efforts. Similar leach tests, sometimes called "synthetic meteoric water leach tests," are commonly used in environmental studies of abandoned mines and mills.

Clear Creek fire, night-time glow, unnamed location, August 2000



Elements Determined / Methods Used

Sample media	Method	Elements determined
Water, filtered/acidified	MW	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs,, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Ho, In, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, Pr, Rb, Re, Sb, Se, Sm, Sr, Tb, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn
	EW	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Si, Sr, Ti, V, Zn
Water, filtered/not acidified	IC	Cl^-, F^-, NO^{3-}, SO_4^{2-}
Sediments	ET	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Eu, Fe, Ga, Ho, K, La, Li, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Sc, Sn, Sr, Ta, Th, Ti, U, V, Y, Yb, Zn
	EP	Ag, As, Au, Bi, Cd, Cu, Mo, Pb, Sb, Zn
	FA	Au
	HY	Se
	CV	Hg

MW, water by ICP mass spectrometry
IC, water by ion chromotography
FA, solid by fire-assay atomic absorption
CV, solid by cold-vapor atomic absorption
EW, water by ICP atomic emission spectrometry
ET, solid by ICP atomic emission spectrometry
HY, solid by hydride generation atomic absorption
EP, solid by partial-extraction ICP atomic emission spectrometry

Most high conductivities in water were from hot springs, which also had the highest pH values (8.7 to 9.4). Stream waters had pH values ranging from 7.1 to 8.6. Note the very low conductivities for many of the streams. Streams having the lowest conductivities are underlain largely by Precambrian quartzites. Certainly there will be short-term effects on local stream water quality during storm and snow-melting events in the months following the wildfires. Will there be evidence of the fires in stream waters beyond the spring flush? Will stream beds become "silted in" with fine sediment, degrading fish spawning beds? Existing geologic maps should be useful in predicting where siltation will occur.

Both stream sediments and water samples were collected at most, but not all, sample sites. While USGS Water Resources Division ppb-protocol procedures for water samples were not followed, clean procedures were used in this reconnaissance study. QA/QC concerns were addressed through the use of site duplicates, analytical duplicates, and standards.

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